

# BMD Technology Program Overview



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Ballistic Missile Defense Organization

DTIC QUALITY INSPECTED 4



## TECHNOLOGY PROGRAM GOALS

*Threats And Technology Do Not Stand Still, Therefore*

- Support Missile Defense With Component Technology Improvement

Increase And Decrease

- Range
- Lethality
- Accuracy
- Effectiveness
- Productibility
- Size
- Cost
- Weight

*Pursue Advanced Concepts For Future Responses To An Evolving Threat*

- New Kill Mechanisms
- High Payoff (Boost-phase Intercept)

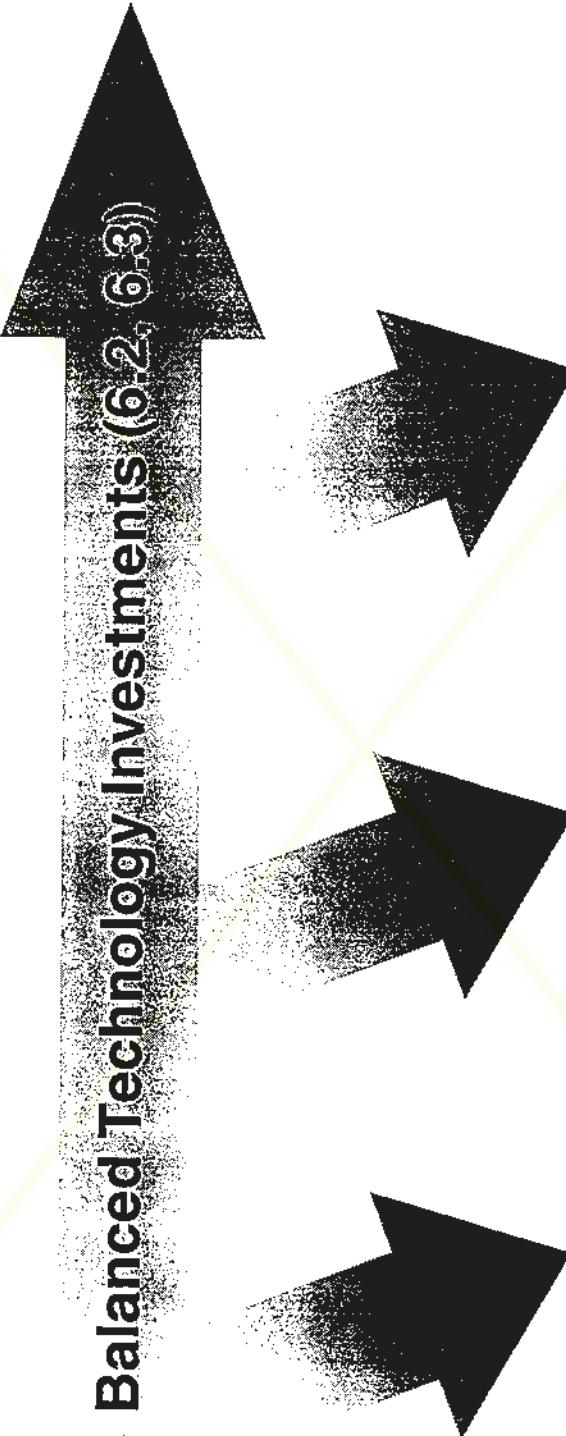
**The Key To Improved Performance And Cost Reduction Is Technology Innovation**



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## TOWARDS A BALANCED TECHNOLOGY PROGRAM

### Balanced Technology Investments (6.2, 6.3)



#### Near-term Technology Infusion

- Cost Reduction
- Risk Reduction
- Shorten Development Timelines

#### Advanced Technologies (Preplanned Product Improvement; New Systems)

- Countering Advanced Threat
- Reduce Cost / Risk
- Increase Effectiveness
- Support Special Missions

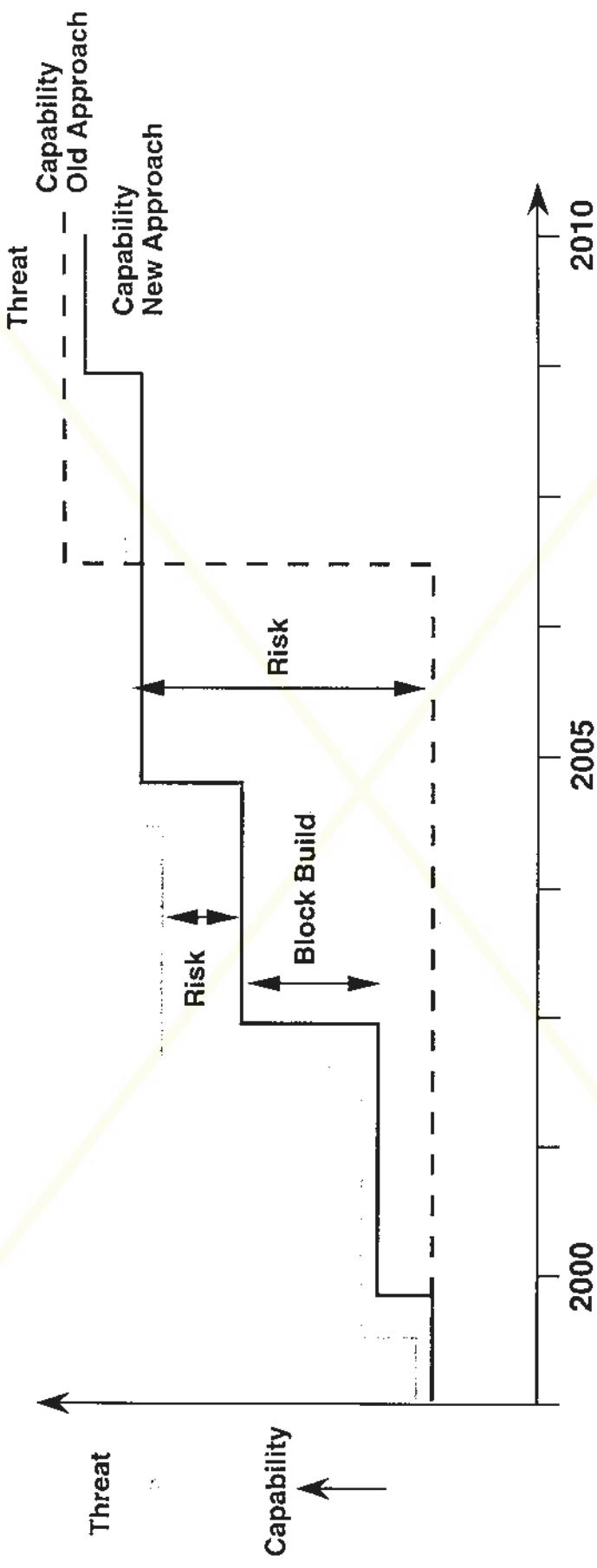
#### Innovative Science And Technology

- Revolutionary Technologies / Processes
- Future Architecture / Operational Concepts



# OPPORTUNITY – MATCHING ARCHITECTURE TO THE THREAT

*Notional Threat*



- Use Continuous Building Block Approach
- Deliver Warfighting Capability Now To Meet Today's Threat
- Lay Out Continuous Implementation / Technology / Funding Road Map To Meet Tomorrow's Threat



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## FACILITATING COST SAVINGS ACROSS THE JOINT MISSION AREA

### *Challenges*

- Redundant Capabilities
- Proprietary Technologies

### *Opportunities*

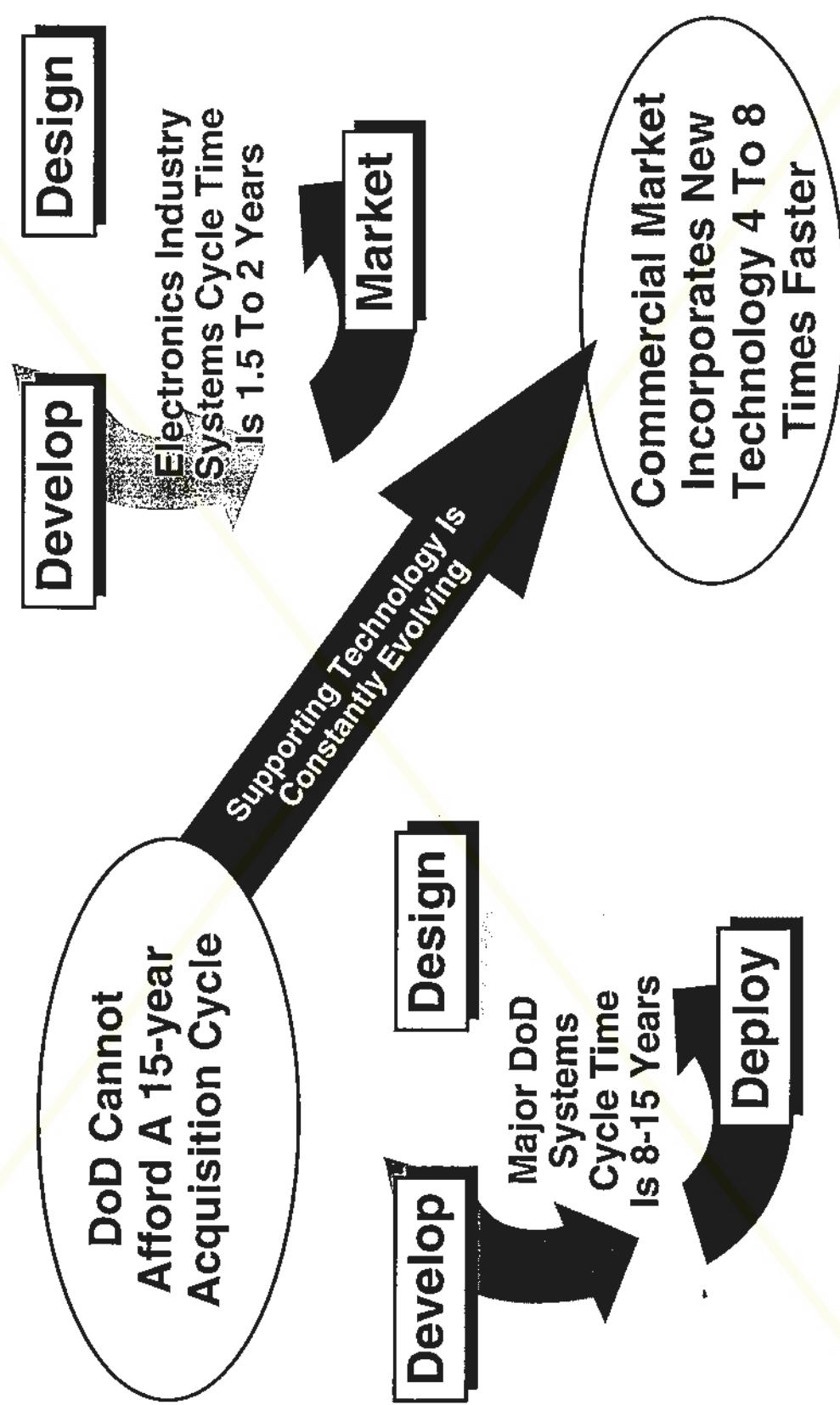
- Define And Implement Open Systems Approach To Hardware Development
  - Plug And Play Modules For Future Architecture / Systems To Lower Cost, Facilitate Interoperability, Reduce Proprietary Solutions
- Rethink The Management Of Risk Reduction Technology Development Programs
  - Focus On Joint Solutions
  - Architecture And System-level As Opposed To Service / Platform Specific

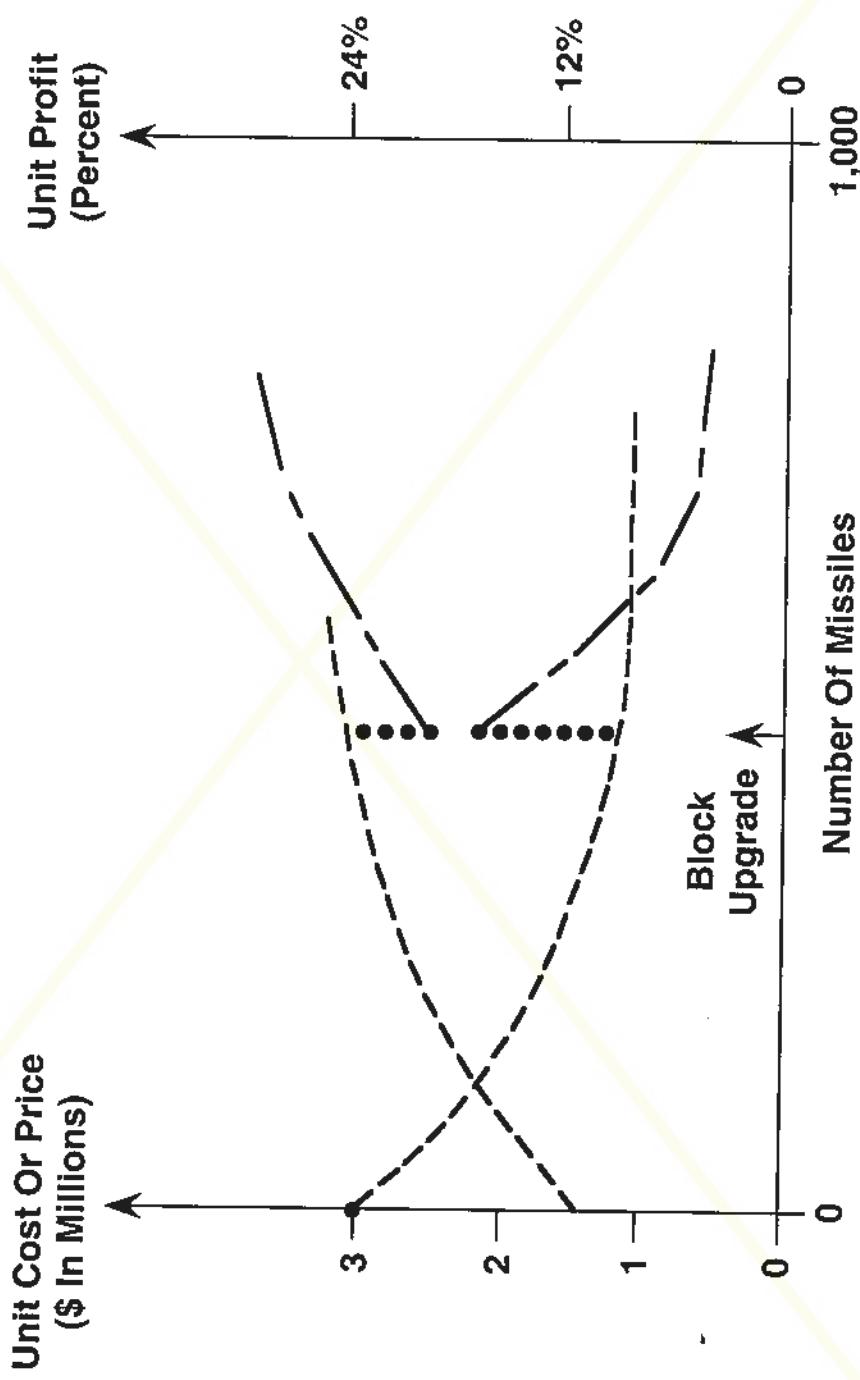
mj-86399 / 110398



## NEAR-TERM TECHNOLOGY INFUSION

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### *Lean Missile Initiative*

## NEW APPROACH





# PROPOSED NEAR-TERM TECHNOLOGY INFUSION PROGRAMS

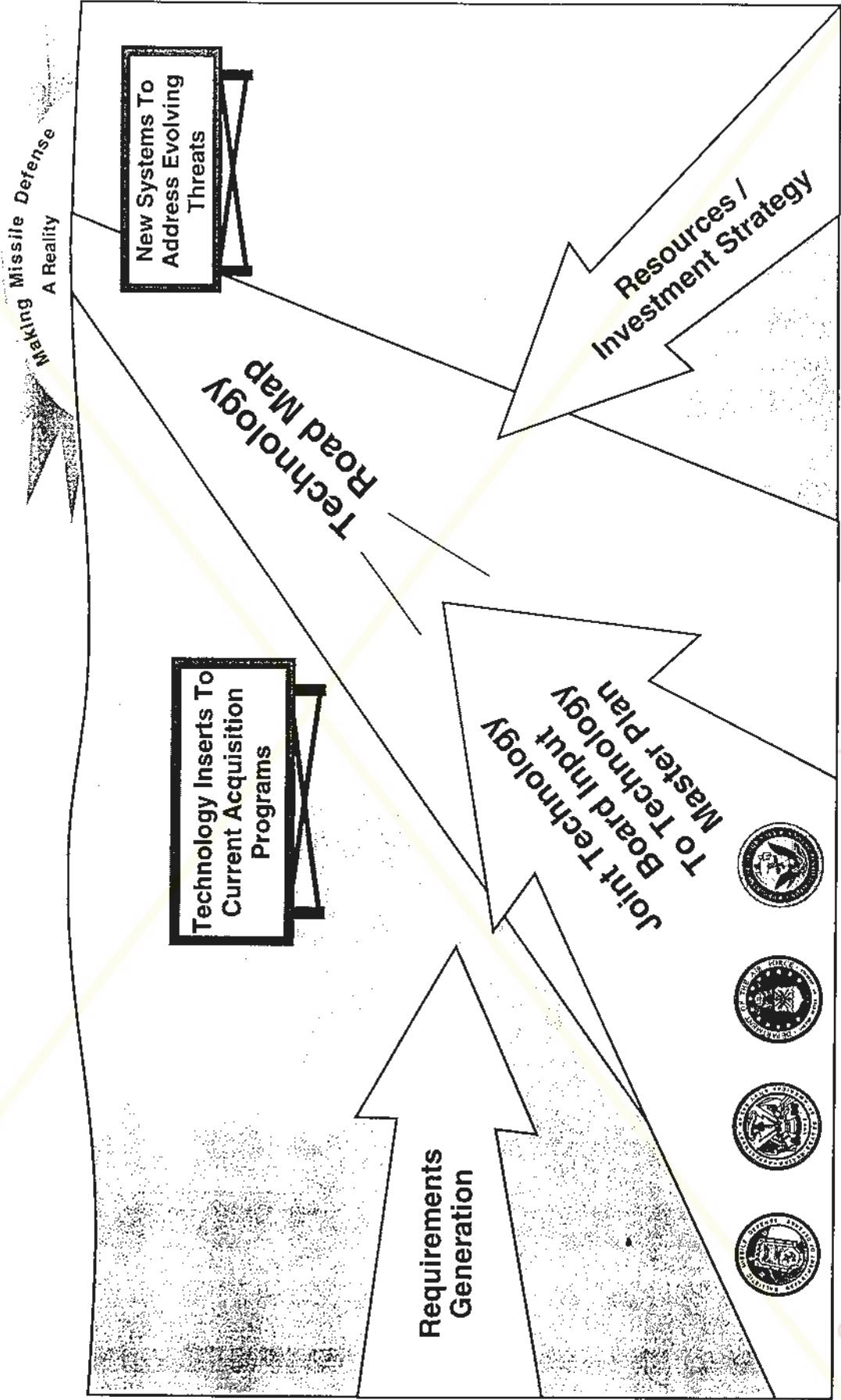
<b>Materials And Structures (Cooperation With Affordable Multi-Missile Manufacturing Program (AM3))</b>	<ul style="list-style-type: none"> <li>• <i>Polymer Matrix Composites*</i></li> <li>• Metal Matrix Composites</li> <li>• Advanced Ceramics For Manufacture Of Radomes / Shrouds</li> <li>• IR Windows</li> </ul>
<b>Propulsion</b>	<ul style="list-style-type: none"> <li>• <i>Component Development / Manufacture For DACS**</i></li> <li>• Energetic Propellants For TMD / NMD Sustainer Engines / DACS</li> </ul>
<b>Sensors (Cooperation With AM3)</b>	<ul style="list-style-type: none"> <li>• <i>Family Of Interferometric Gyro-based INS Systems For Interceptors*</i></li> <li>• Transmit / Receive Module Cost Reduction</li> <li>• Solid-state Transmitter For PAC-3 / MEADS**</li> <li>• Focal Plane Array Productivity</li> <li>• Master Frequency Generator*</li> </ul>
<b>Signal Processing Electronics (Cooperation With AM3)</b>	<ul style="list-style-type: none"> <li>• COTS-based Radar Architectures</li> <li>• <i>Advanced Signal Processing For Seekers / Radars / Electro- Optics**</i></li> </ul>
<b>BM/C<sup>3</sup> Hardware</b>	<ul style="list-style-type: none"> <li>• Large, Ruggedized Displays For BM/C<sup>3</sup> Centers</li> <li>• Asynchronous Transfer Mode Communications</li> <li>• Microwave Power Modules</li> </ul>
<b>Batteries</b>	<ul style="list-style-type: none"> <li>• Advanced Thermal / Lithium Batteries</li> </ul>

\* Ongoing Project      \*\* Proposed 1999 Project

mi-90877 / 040899



# TECHNOLOGY PROGRAM PLANNING





# TECHNOLOGY MASTER PLAN

## OBJECTIVES

- Greater Understanding Of The Evolving Threat And Mission Essential / Enabling Capabilities
- Develop Technologies That Keep Pace With The Threat, Reduce MDAP Costs, And Mitigate Risk
- Identify Timelines For Technology Development
- Align Existing Technology Programs, Leverage Service Technology Programs, And Develop New Technology Programs To Meet FoS And NMD Needs
- Determine Level And Timing Of Required Financial Resources

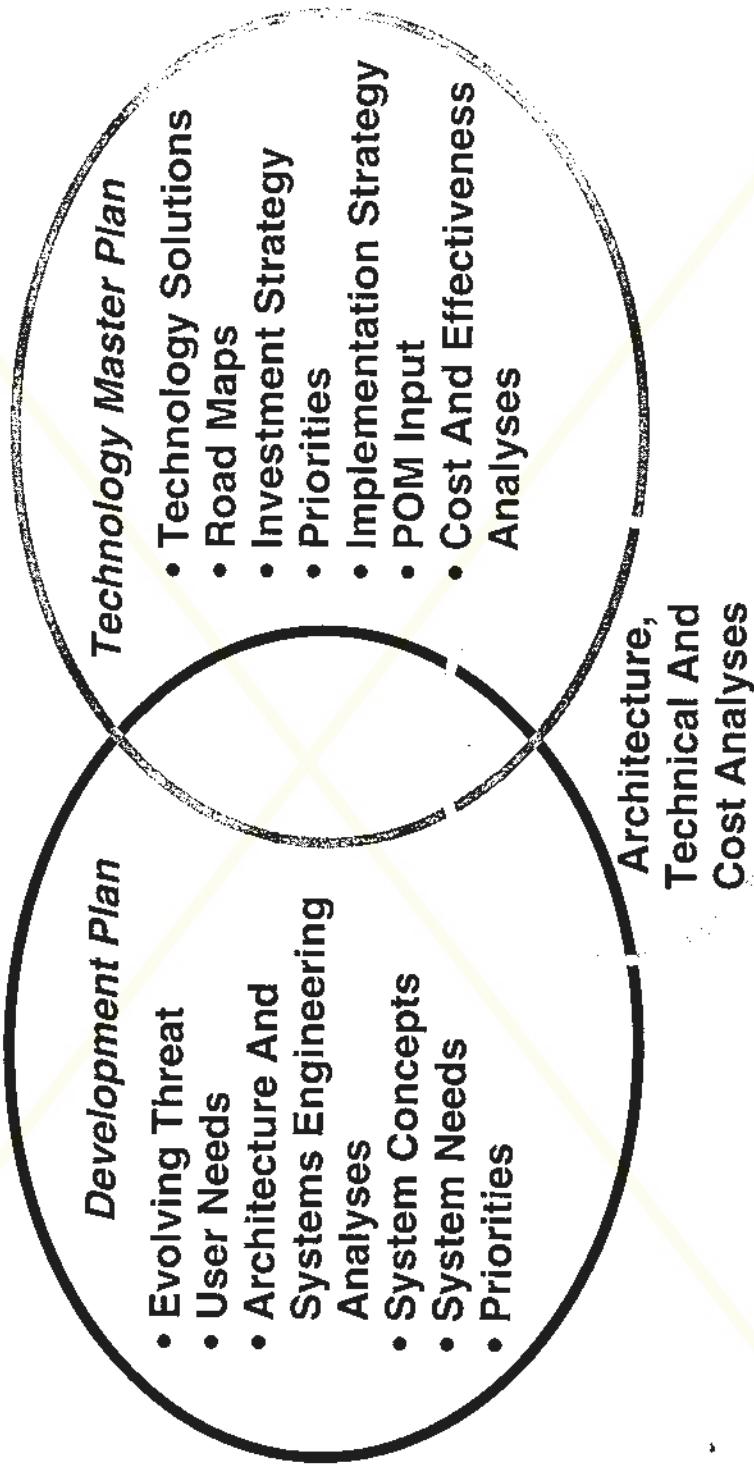
It Is Not Uncommon For People To Equate R&D With The Development Of Hardware, A View Which Is As Limited As It Is Erroneous. The Product Of The R&D Effort Is An Operational Capability. Weapons Hardware Is But One Subsystem Of Operational Capability. This Point Must Be Reemphasized; The Objective Of R&D Is Operational Capability, Not Hardware Per se.

DON RDT&E / Acquisition Management Guide



# BMDO PLANNING FOR TECHNOLOGY INVESTMENT

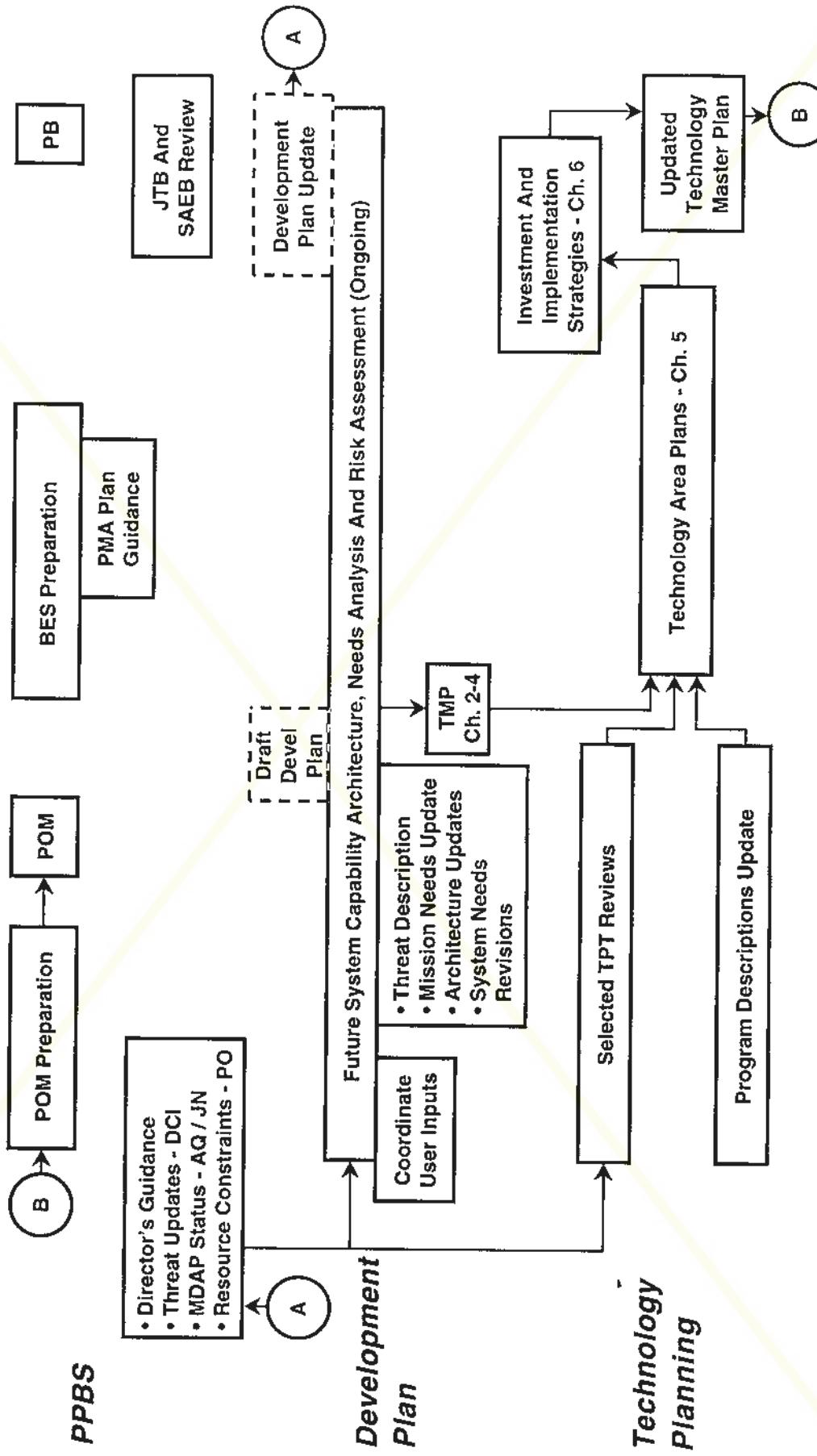
*The Development Planning Process Provides BMDO's System Needs For Technology And Basis For Investment*



**The Technology Master Plan Defines BMDO's Investment And Approach To Obtaining The "Needed" Technology**

ANNUAL TMP PROCESS

**DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR**





# CHALLENGE: INVOLVING THE CONTRACTOR COMMUNITY

- Government-Industry Open System Applications Group
  - Strategic Partnership With DARPA Affordable Multiple Missile Manufacturing (AM3) Program
  - Initial Meeting Held 18 MAR 98
- Establish Best Practices And Standards For
  - Key Hardware Components
    - Examples: Guidance And Control, T / R Modules, Propulsion, Materials And Structures, Signal Processing Electronics, etc.
  - Grow To Include Key Software Applications (Treat As Components)
    - Examples: BM/C<sup>3</sup>, Hit-To-Kill Guidance, Discrimination, etc.
  - Extend To Include Key Infrastructure Elements
    - Examples: M&S, Testing, Data Analysis And Handling, etc.

## INDUSTRY REVIEWS



- TMP Coordinator Will Schedule Industry Meetings Through The GOSAG
  - BMDO Programs Will Be Presented To Industry
  - Two-way Exchange Of Information On Programs, IRAD, And Technology Needs With Each Individually
  - TPT Cochairs And Industry Representatives Will Attend



## TECHNOLOGY PLANNING TEAMS (TPT)

- TPT Areas
  - Interceptors
  - Surveillance
  - BM/C<sup>4</sup>I\*
  - Directed Energy\*
- Responsibilities
  - Identify Programs That Meet Technology Needs
  - Develop Technology Area Plans
  - Tailor Or Leverage Existing Programs Where Possible, Otherwise Recommend New Starts
  - Produce Technology Road Maps
  - Prioritize Technology Programs

\* Formed 1998

mj-82674 / 051298



# TECHNOLOGY PROGRAM APPROACH

Threat	Stressed BMD Function	System Need For Technology	Technology Focus
<ul style="list-style-type: none"> <li>Penails           <ul style="list-style-type: none"> <li>- Jammers</li> <li>- Flares</li> <li>- LREPs</li> <li>- Aerosols</li> <li>- Coatings</li> <li>- Chaff</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Discrimination</li> <li>Kill Assessment</li> <li>Track And Track Accuracy</li> </ul>	<ul style="list-style-type: none"> <li>RF / IR Discrimination</li> <li>Signature</li> <li>Characterization</li> <li>Multiple Sensor Data Fusion</li> <li>TOM Generation</li> <li>High Performance Data / Signal Processing</li> </ul>	<ul style="list-style-type: none"> <li>Integrated Active / Passive Seeker</li> <li>Multicolor Seeker (IR)</li> <li>Laser Radar / Interrogator / Imaging Radar</li> <li>Discrimination / Sensor Fusing Algorithms</li> <li>Wave Front Sensing</li> <li>Wideband Radar Processing</li> <li>High-power / Efficiency T/R Modules</li> <li>High-G Divert</li> <li>BM Logic For Object Sampling</li> </ul>
<ul style="list-style-type: none"> <li>Advanced Submunitions</li> </ul>	<ul style="list-style-type: none"> <li>Intercept Timeline</li> </ul>	<ul style="list-style-type: none"> <li>Surveillance</li> <li>Boost Phase Intercept</li> <li>Kinetic Energy</li> <li>Directed Energy</li> <li>Multiple Sensor Data Fusion</li> </ul>	<ul style="list-style-type: none"> <li>Cooled Window</li> <li>Wide Field Of Regard Seeker</li> <li>Plume / Hard Body Aim Point</li> <li>Blended Aero / Divert</li> <li>Typing</li> <li>Detection / Background Suppression Algorithms</li> <li>Wave Front Sensing</li> <li>Multispectral Sensor Fusion</li> <li>High-power / Efficiency T/R Modules</li> </ul>
<ul style="list-style-type: none"> <li>Way Point Navigation</li> <li>Multi-axis Attacks</li> <li>Very High-G Maneuver</li> <li>Reduced RCS (VLO)</li> <li>Very Low Altitude</li> </ul>	<ul style="list-style-type: none"> <li>Lethality</li> <li>Maneuverability</li> <li>Minimum Intercept Altitude</li> <li>Surveillance</li> <li>Battle Management</li> <li>Affordability</li> </ul>	<ul style="list-style-type: none"> <li>Safe High Performance DACS</li> <li>Traffic Handling</li> <li>Lower Tier Discrimination</li> <li>Processing And Algorithms</li> <li>Reduced Life Cycle Cost</li> </ul>	<ul style="list-style-type: none"> <li>High-G Fast Response Divert</li> <li>Maneuvering Target Algorithms</li> <li>Wide Field Of Regard Seeker</li> <li>Fast Frame FPA / On FPA Motion Detector</li> <li>RF / IR Apertures</li> <li>Blended Aero / Divert Control</li> <li>Real-time Data Processing / Fusion</li> <li>High-power / Efficiency T/R Modules</li> <li>VLWIR Multiple Quantum Well FPA</li> <li>Waveform Sensing</li> </ul>



## INTERCEPT FOCUS AREAS

- Atmospheric Interceptor Technology (AIT)
  - Advanced Lower Tier Intercept Technology
  - Endoatmospheric Seekers, Windows, Interceptor Agility, Safe DACS, Optimal Guidance, Estimation Of Target Maneuvers
- Exoatmospheric Interceptor Technology (EIT)
  - Advanced Technologies For NMD And TMD Upper Tier
  - Multicolor Focal Plane Arrays, Laser Radar, Advanced Processors, Algorithms
- Boost Phase Intercept (BPI)
  - Target State Estimation Sensors And Algorithms, Missile Plume To Hard Body Handover



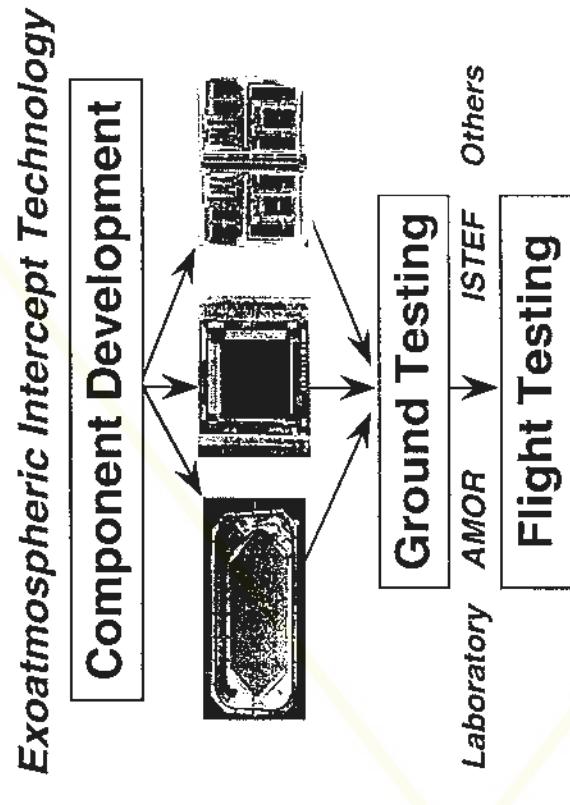
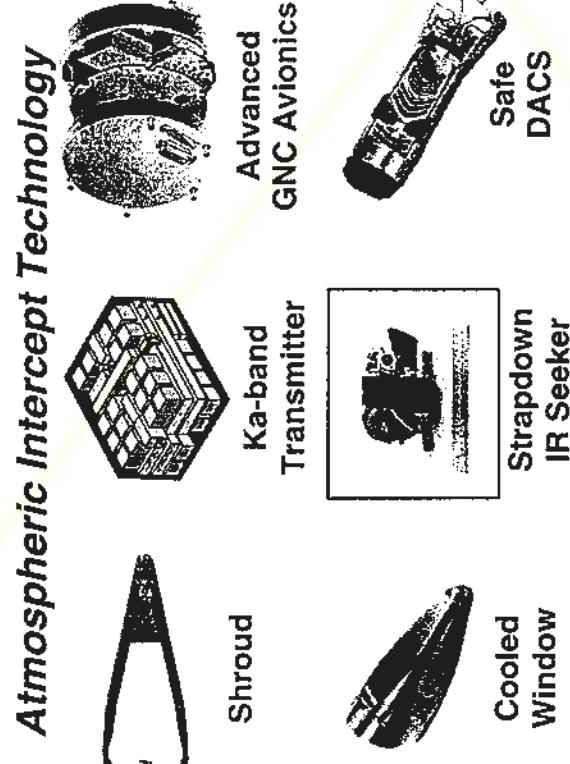
## TMF TECHNOLOGY AREAS

- Atmospheric Interceptor Technology (AIT)
- Exoatmospheric Interceptor Technology (EIT)
- Boost Phase Intercept Technology (BIT)
- Advanced Radar Technology (ART)
- Advanced Passive Technology (APT)
- Advanced Mission Technology (AMT)
- BM/C4I Advanced Technology (BAT)
- Directed Energy Technology (DET)



# INTERCEPT INTEGRATED TECHNOLOGY PROGRAMS

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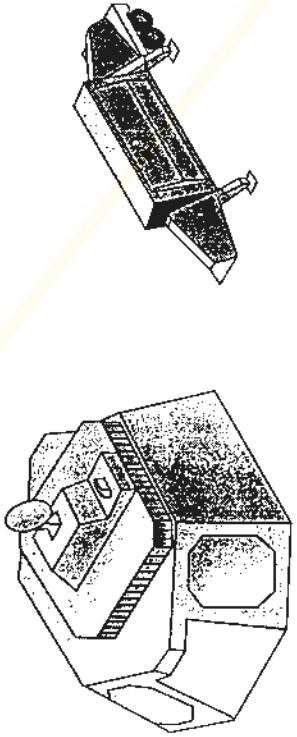
- The BMDO Technology Master Plan (TMP) Is The Foundation For Restructured Intercept Technology Programs
- Intercept Technologies Are Better Tied To MDAP Needs
- New Technologies Will
  - Respond To Evolving Threat
  - Enhance Current MDAP Performance
  - Improve Affordability / Reliability



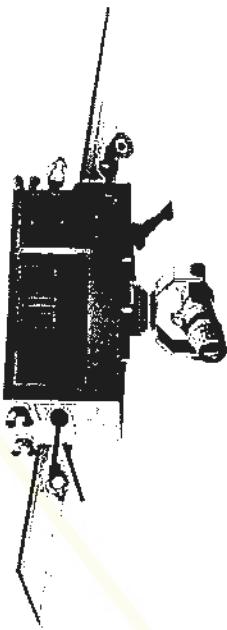
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## SURVEILLANCE INTEGRATED TECHNOLOGY PROGRAMS

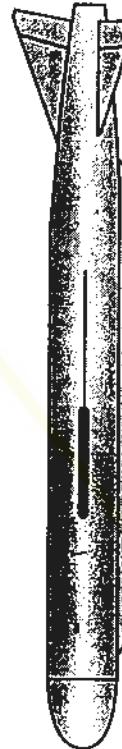
### *Advanced Radar Technology (ART)*



### *Advanced Passive Technology (APT)*



### *Advanced Mission Technology (AMT)*



- The BMDO Technology Master Plan (TMP) Is The Foundation For Surveillance Technology Programs

- Surveillance Technologies Are Directly Tied To MDAP Needs

- Technology Efforts Will
  - Meet Current MDAP Requirements
  - Respond To Evolving Threat
  - Improve Affordability / Reliability

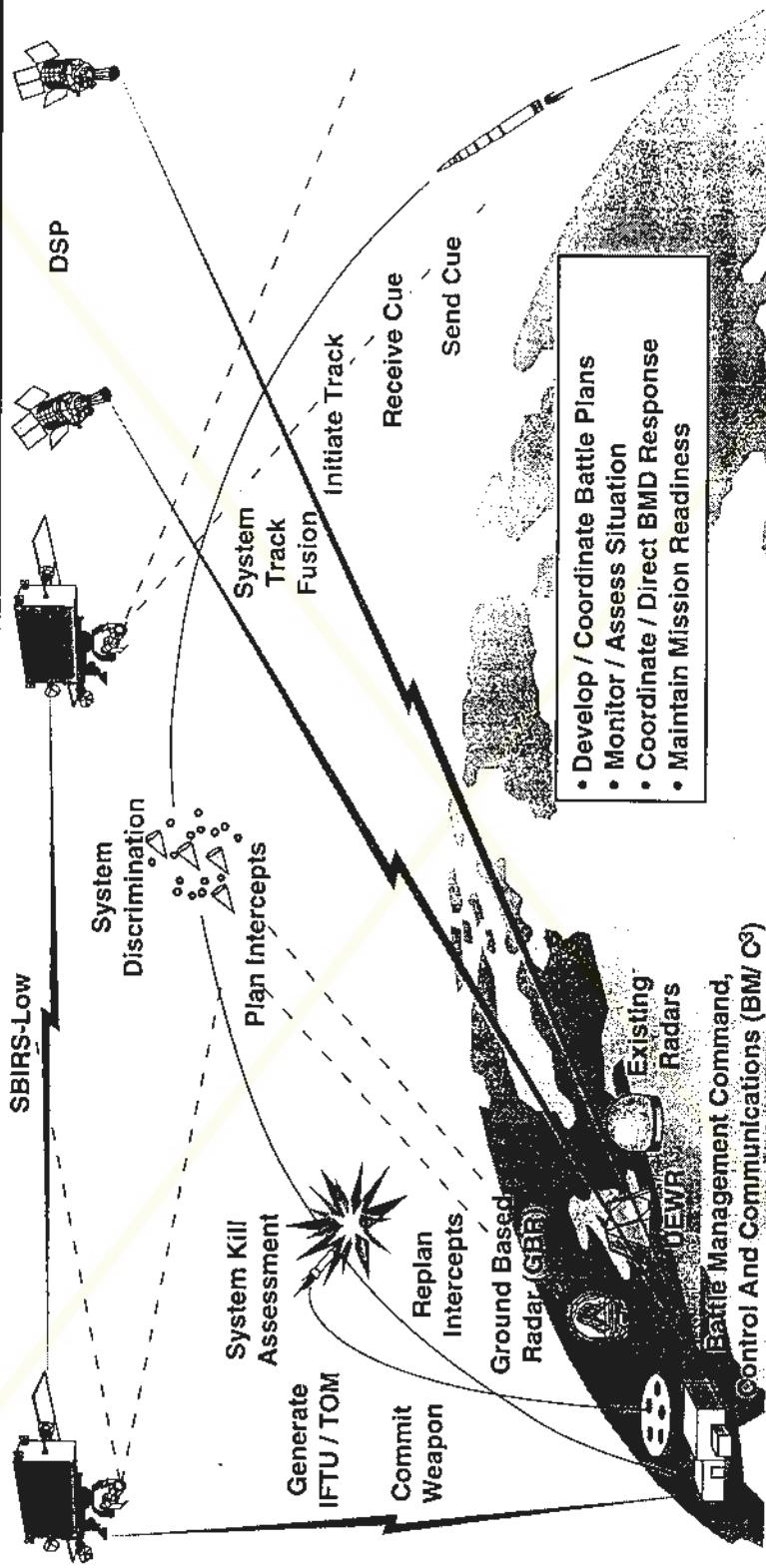


## SURVEILLANCE FOCUS AREAS

- Advanced Radar Technology (ART)
  - Increased Power Aperture And Beam Agility, Enhanced Waveform Design
  - Low Cost T / R Modules, Improved Processors, Advanced Algorithms
- Advanced Passive Technology (APT)
  - Advanced Components For Satellite Surveillance, Acquisition, Track, Discrimination, Kill Assessment (SATDKA)
  - Improved FPA Uniformity, Longer Wavelengths, Optics Cleaning, Cryocoolers, Radiation Hardened Electronics
- Advanced Mission Technology (AMT)
  - SATDKA Functions For Cruise Missile Threat



# BM/C<sup>4</sup>I ADVANCED TECHNOLOGY (BAT)



## Defense Against Strategic Ballistic Missiles

- The BMDO Technology Master Plan (TMP) Is The Foundation For Restructured BM/C<sup>4</sup>I Technology Programs
- BM/C<sup>4</sup>I Technologies Are Tied To MDAP Needs
  - New Technologies Will
    - Improve Battle Management In Response To An Evolving NMD / TAMD Threat
    - Enhance Current MDAP Performance And Improve Affordability / Reliability
    - Address Advanced Mission Threat Battle Management

## BM/C<sup>4</sup>I FOCUS

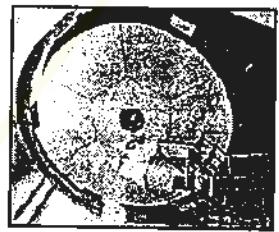


- BM/C<sup>4</sup>I Advanced Technology (BAT)
  - Use Open Systems Standards, Leverage Communications Infrastructure
  - Battle Management Technology, Situation Awareness, Kill Assessment, Evaluation Tools

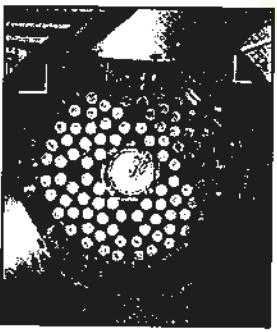


# DIRECTED ENERGY TECHNOLOGY DEVELOPMENT CONCEPT

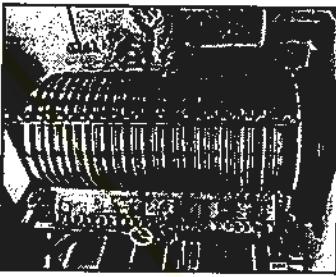
## Demonstrated Technologies



Large Optics  
(LAMP, 1989)



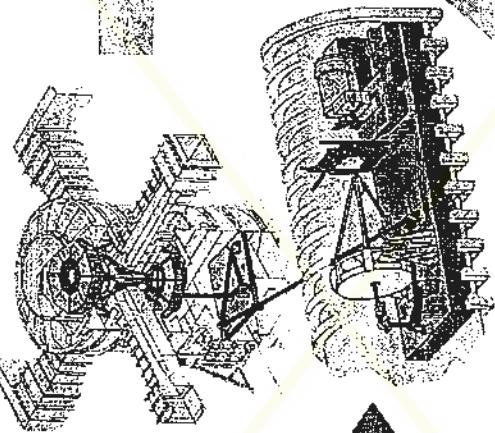
Beam Control  
(LODE, 1987)



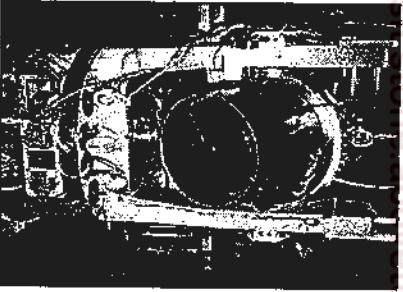
Laser  
(Alpha, 1991)

## Integration

Alpha LAMP Integration (ALI)  
End-to-end Weapon Element Testing

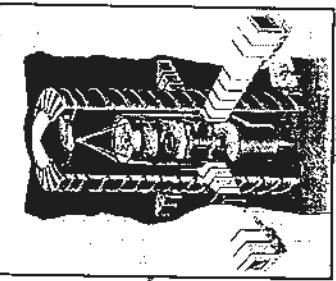


*Acquisition, Tracking, Pointing  
And Fire Control*  
(High Altitude Balloon Experiment (HABE))

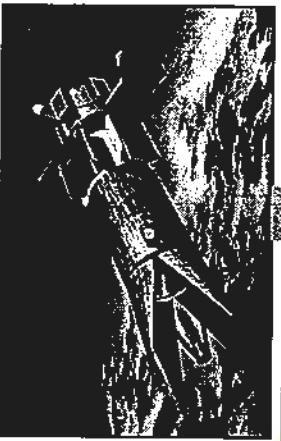


## System-level Development

Integrated Ground Demonstrator (IGD)



Integrated Flight Experiment (IFX)



Future Operational SBL



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## DIRECTED ENERGY FOCUS



- Directed Energy Technology (DET)
  - Integrated Technology For Space Based Laser
  - Integrated Flight Experiment (IFX)
- Precision Pointing, Waveform Sensing Adaptive Optics, Advanced Beam Generation

## RESEARCH / EXPLORATORY DEVELOPMENT (IS&T, SBIR)



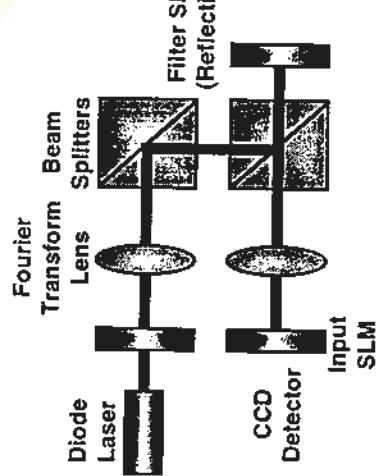
- Innovative Science And Technology (IS&T)
  - Research And Exploratory Development Targeting Breakthrough Technologies For Ballistic Missile Defense
  - Core R&D Program In Sensing, Directed / Kinetic Energy, Materials, Propulsion, Power, And Information Processing
- Small Business Innovative Research (SBIR)
  - Mandated Percentage Of Extramural R&D



# INNOVATIVE RESEARCH - HIGH RISK TECHNOLOGY FOR BMDO'S FUTURE

## Development Of Grayscale Optical Correlator

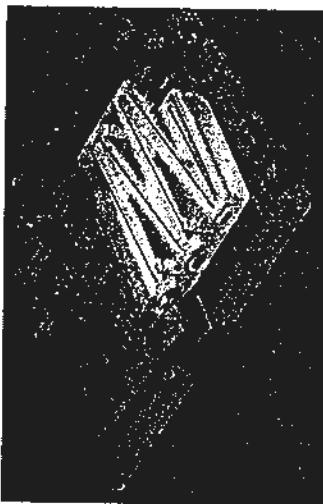
### Optical Correlator Schematic



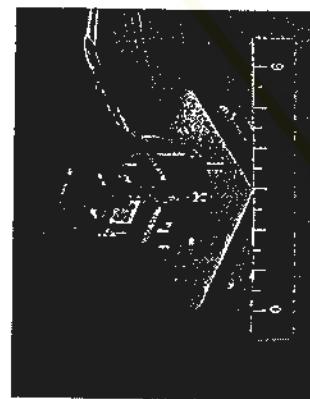
BMDO Funded Camcorder-sized  
Grayscale Optical Correlator  
JPL – 1998



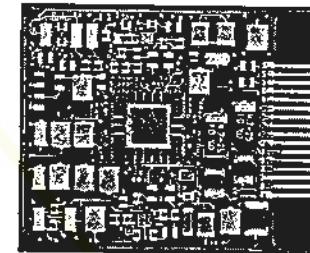
Matchbox-sized Optical Correlator To Be Delivered For  
DoD And NASA Applications



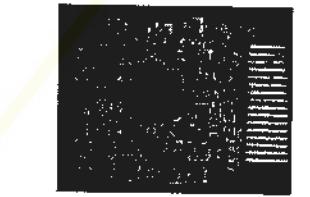
## 1998 INS / GPS



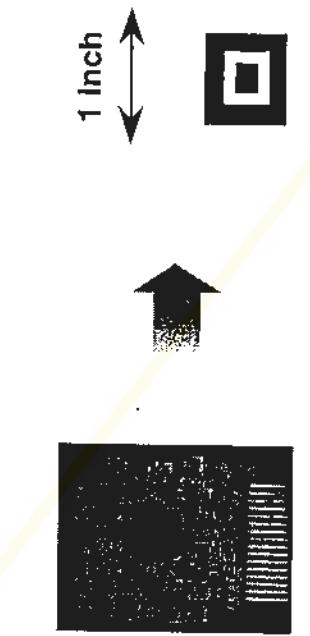
6-dof ISA  
3 cu in



1997  
0.47 cu in  
Commercial Gyro



1998  
0.35 cu in  
High Performance Gyro



1999  
0.17 cu in  
High Performance Gyro



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## INNOVATIVE SCIENCE AND TECHNOLOGY

### Description



### Issues

- Rapid, Drastic Funding Reductions Are Devastating To Innovative Research And Will Limit BMDO's Ability To Meet Advanced Threats
- Current Program Supports Several Key Technologies And Closes Out Many Others, No Significant New Starts
- Funding Reductions In Opposition With Recent Congressional Language

### Benefits / Applications

- Keeps BMDO On "Cutting Edge" Of Technology, BMDO's Investment In The Future
- Identifies And Develops Key New Technologies To Meet Emerging And Far-term Threats
- Provides Innovative Upgrades For Existing Systems
- MDAP Relevance: Generic High Payoff Technologies For TMD/NMD/CMD Applications

### Budget / Selected Products

FY 00 PB (FY \$M)					
FY 95	FY 96	FY 97	FY 98	FY 99	FY 00
\$80.00	\$65.00	\$52.00	\$52.82	\$22.98	\$7.86

- SCARLET Arrays And Hall Thrusters For SBIRS-class Programs
- Advanced Thermal Batteries For THAAD
- Lasercom For Rapid, Secure Communications
- Miniature Interceptor Technology For Advanced Submunitions
- Advanced Sensors / Sugar Cube Processor / Neural Net Algorithms For BMD / CMD ATR

## IMPLEMENTATION STRATEGY



- Based On Director's Guidance To Allocate 10% (Minimum) – 12% (Goal) Of BMDO Total Obligational Authority To Technology Development
  - Includes Set-asides (e.g., SBL Readiness Demonstrator, SBIR)
- Consistent With Technology Priorities
  - Solution Or Mitigation Of A Critical Challenge
  - Cost Reduction
  - Multiple Potential Applications
  - Breakthrough Technologies



## A NEW APPROACH

- Building Consensus Requires New Approach
  - Relate Technology Programs To Military Deficiencies, Technology Needs And Operational Capability
  - Establish Process For Corporate Participation And Decision Making
  - Develop A Product To Guide And Coordinate Missile Defense Technology Programs
- The Technology Master Plan Process Incorporates This Paradigm Shift



## SUMMARY

- BMDO TMP Is The Vehicle For Implementing Director's Guidance For Technology
  - Maintain U.S. Technical Superiority In Missile Defense
  - Relate BMDO Technology To MDAP Needs And Operational Capabilities
  - Allocate A Goal Of 12% Of TOA, But Not Less Than 10% For BMDO Technology Program
  - Maximize Participation Of Missile Defense Community In BMDO Technology Program